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ABSTRACT

"English in Action," (EIA) an interactive audio instructional system using instructional cassette or radio, when available, was implemented in first and second grade classrooms in South Africa, in 1993 and 1994, respectively. This case study looks at the economics of alternative ways to implement and expand the "English in Action" system, both with respect to the content and delivery mechanisms of the program and with respect to its organization. It identifies several audiocassette and radio broadcast alternatives, together with three different models of teacher development and support. Class sizes vary considerably in South Africa, as do the costs of reaching urban and rural schools, so the study provides costs of the various strategies for a variety of class sizes and geographic locations. Many design choices vary in cost according to how much support is provided to teachers, so materials costs for classroom materials and for teacher development are estimated separately. Costs vary from around R3.50 (approximately US$1) to R30 (approximately US$8.50) per pupil per year for materials acquisition and airtime costs. The cost of teacher development and support varies from R140 (US$40) per year to R640 (US$180) per teacher for the first, more intensive year, and from R83 (US$25) to R214 (US$60) per teacher in subsequent years for continuing teacher support and development. The utility of the study for other countries is not that it demonstrates that EIA costs a certain amount per pupil in South Africa, but that it demonstrates the cost elements that should be considered when looking at the use of multichannel approaches to learning, and how an economist deals with the economic and political uncertainty when predicting the costs of taking an innovation to scale. Five tables and three figures illustrate data. (MAS)

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THE ECONOMICS OF INTERACTIVE INSTRUCTION:

THE CASE OF SOUTH AFRICA

LearnTech Case Study Series No. 7

by James Cobbe

May 1995

U.S. DEPARTMENT OF EDUCATION
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Foreword

Would-be users of interactive instruction often ask what it costs. To reply, "How long is a piece of string?" is unhelpful and sounds 1) evasive or 2) that you don't know. The truth is that, like most educational investments, the cost varies according to local conditions and the design choices that are made. This case study is based on the cost study carried out in South Africa by Dr. James Cobbe. It lays out clearly, but in detail, the technical and economic issues that molded the choices made for this iteration of interactive instruction, and describes how the designers responded to them.

The study was commissioned by LearnTech as part of a bigger activity funded by the U.S. Agency for International Development to develop interactive, multichannel approaches to basic education to teach English and mathematics. Development of strategies and materials had begun before the new Government took over in 1994, and were intended to provide one answer to the overwhelming need to improve the quality of basic education in African primary schools. Between June 1992 and March 1995, LearnTech assisted a South African NGO, the Open Learning Systems Educational Trust (OLSET) to develop language programs for the first two grades of primary school. *English in Action* (EIA) was designed specifically for African primary pupils in South Africa, although it drew on experience in other countries. EIA included a strong teacher development and support component, because South African educators considered it essential in the context of African primary schools in South Africa. During the pilot phase, audio lessons were delivered by cassette, but the intent was to use radio when broadcasting systems became available.

English In Action 1, (EIA1) was implemented in 1993 in 105 schools and 287 Grade One classes, and was used by 13,126 pupils. In 1994, EIA1 was in use by 15,192 pupils in four provinces and *English In Action 2*, (EIA2) was being used by 9,574 Grade Two pupils. At the time of writing, in early 1995, the Grade 1 programs are being broadcast nationally on Radio 2000, Monday through Friday. A national chain of newspapers, the Argus, has agreed to publish teachers' notes and student worksheets to complement the daily broadcasts.

At the same time as EIA was being developed, other initiatives were progressing towards the same end. Plainly, the new provincial governments would need cost data as well as data on effectiveness in order to make informed choices about which systems to adopt. The study was completed in July 1994, and tried to establish the cost of taking the pilot system to scale. The original Cobbe Report, on which this case study is based, analyzed the costs of developing and delivering *English in Action* (EIA), and projected probable future costs if the program were to be significantly expanded.

This case study looks at the economics of alternative ways to implement and expand the system, both with respect to the content and delivery mechanisms of the program and with respect to its organization. It identifies several audiocassette and radio broadcast alternatives, together with three different models of teacher development and support. Class sizes vary considerably in South Africa, as do the costs of reaching urban and rural schools, so the study provides costs of the various strategies for a variety of class sizes and geographic locations. Many design choices vary in cost according to how much support is provided to teachers, so materials costs for classroom materials and for teacher development are estimated separately. Costs vary from around R3.50 (approximately US$1.00) per pupil per year to R30 (approximately US$8.50) per pupil per year for materials acquisition and airtime costs. The cost of teacher development and support varies from R140 (US$40) per year to R640 (US$180) per teacher for the first, more intensive year, and from R83 (about US$25) to R214 (US$60) per teacher in subsequent years for continuing teacher support and development.

The utility of the study for other countries is not that it demonstrates that EIA cost a certain amount per pupil in South Africa, but that it demonstrates the cost elements that should be considered when looking at the use of multichannel approaches to learning, and how an economist deals with economic and political uncertainty when predicting the costs of taking an innovation to scale. Hopefully the study will allow potential users to measure the piece of string for themselves.

Michael Laflin

"English in Action" in South Africa

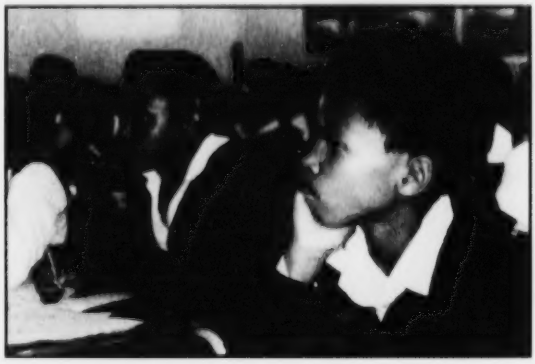
English in Action (EIA), an interactive English as a Second Language program specifically designed for the first two grades of African lower primary schools in South Africa, was developed between 1992 and 1995. Although Learntech's experience with primary school interactive radio English programs in Lesotho and Kenya provided a huge bank of ideas and scripts, South African educators and linguists had their own ideas about how to teach language that the existing scripts often could not accommodate. So EIA1 substantially adapted earlier programs, and EIA2 programs were developed virtually from scratch. The pilot program was delivered on cassette, and had a substantial teacher support and development component. Cassettes were used for delivery of audio to the schools because, when the program was first implemented in 1993, conditions in South Africa were such that South Africa Broadcasting Corporation radio was not a feasible delivery system, although this prohibition disappeared with the election of the new Government of National Unity in April 1994. The teacher support and development component is stronger than in many comparable programs in other countries because of the imperative to build into any lower primary ESL program in South Africa elements that strengthen teachers' skills as well as provide instruction to students.

Interactive Instruction in the Classroom

Interactive audio is very different from conventional schools broadcasting. The basic idea of interactive audio is that both teacher and pupil interact with the audio, rather than listening passively. Thus the audio lesson asks the teacher and the pupil to do things or respond frequently throughout each audio lesson. In order for this to work, teachers need some initial training in how to use the audio lessons, and both teachers and pupils need to have some materials other than their ears. Typically, teachers have manuals that lay out in detail each audio lesson, and include suggestions as to what they should do, and explanations of what the lesson is attempting to achieve. In addition, there are usually some class materials, such as posters, to which the audio lesson can refer, and pupils have printed materials to which the audio also refers and instructs the pupils to use.

Interactive audio, usually delivered by radio, has been in use in primary schools for twenty years in various countries, including Nicaragua, Kenya, El Salvador, Dominican Republic, Thailand, Nepal, Venezuela, Papua New Guinea, Bolivia, Honduras, Costa Rica and Lesotho. In general, evaluation studies seem to agree that pupils using interactive audio learn more than pupils in equivalent conventional classrooms, with the greatest advantage to interactive audio typically found in rural or peri-urban settings rather than urban ones (Anzalone, 1987, 1991; Searle, 1988; Tilson et al., 1991; Tilson, 1994). Evidence in South Africa is consistent with this finding. Although some critics have questioned overly rosy accounts of interactive audio (e.g. Klees, 1994), it is clear that the dominant view is that interactive audio works, has advantages over conventional classrooms for languages and mathematics in primary schools, has its largest advantages in rural or peri-urban areas, and is usually estimated to be cost-effective compared to other feasible interventions such as more conventional textbooks.

EIA was designed specifically for African pupils.



English in Action and its Audience

Prior to 1994, the vast majority of African pupils attended schools run by the Department of Education and Training (DET) responsible for Africans in the 'common' areas of the country, and the ten authorities of the various bantustans. In most cases, instruction was in the dominant vernacular, and English was not introduced in lower primary classes. Recent changes in South Africa have had two immediately relevant implications: first, the administration of education will be completely reorganized, with a single national Department of Education and nine new provincial

authorities, with responsibility for education of all pupils within their geographic areas (the new provinces); and, second, policy on languages in schools has changed considerably. Decisions on language or languages of instruction are matters of community choice, subject to fairly permissive guidelines, and many African schools are introducing English as a subject in Grade 1 and switching to English as a language of instruction earlier than was the case in the past.

EIA was specifically aimed at African pupils for two reasons. First, this was where the need for improved ESL instruction was, and remains, the greatest. Second, for historical and environmental reasons the existing materials for English are not very suitable for African pupils. Accordingly, OLSET has written heavily adapted scripts for EIA1, and completely new scripts for EIA2, recorded them, and distributed them to participating schools together with appropriate supporting print materials.

The EIA Package

EIA1 presently consists of 130 interactive audio lessons, each 30 minutes long, contained on 65 cassettes. It is supported by a 152-page teacher's manual, containing detailed notes on each lesson, and a pupil book of 12 pages, probably to be expanded to 20 pages. Each class also receives color charts, an alphabet frieze, 2 full-color posters, and twelve A3 blow-ups of the pupil book pages. The full audio program starts in the second term of the school year, and is preceded by activities supported by a 'readiness kit,' which consists of one cassette, a teacher's manual, and other print material totaling 43 pages, in the first term. EIA2 has 130 interactive audio lessons, also 30 minutes long, a teacher's manual of 160 pages, pupil books of 28 pages, a 32-page comic book in full color, six loose pages of puzzles and quizzes to assist teachers with assessment; and one color poster.

OLSET has also developed a teacher support package based on introductory training workshops, teacher support groups [TSGs] meeting during the school year, classroom visits by regional coordinators, and mid-year and end-year one-day workshops. Parts of this teacher support package involve the use of specially developed audio and video cassettes. Teachers participating in the program for a second time have a one-day refresher workshop before the start of the school year, and participate in half the

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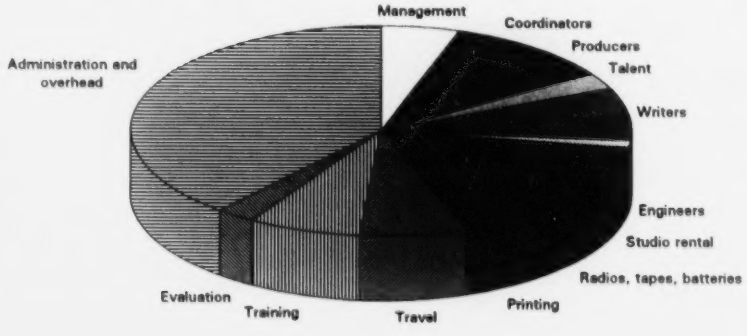
number of TSGs as in the first year. There are two teacher training audiocassettes and a small number of videos, which are used in workshops and other teacher development meetings.

The Cost of Developing EIA

Educators thinking about using interactive instruction generally ask first about the cost of developing the programs for schools, so we deal first with the development costs. The rest of the study will focus on the economics of implementing interactive instruction nationally and will regard the development costs as "sunk".

OLSET spent about 5 million Rand on EIA between April 1991 and May 1994 to produce the package described above. Over the three year period, **salaries** accounted for about R1.35 million or 27%. Salaries included management of the activity, writers, radio producers, engineers, desktop publishing staff, actors, musicians and composers, and regional coordinators. **Travel costs** were about 7%, of which about half was used by the regional coordinators visiting schools and communities. **Other direct costs** accounted for 23% of the five million, and included studio rental, buying radios, tapes and batteries; and printing teacher guides, workbooks, posters and charts. **Administration and overhead charges** were about R1.9 million or 38%.

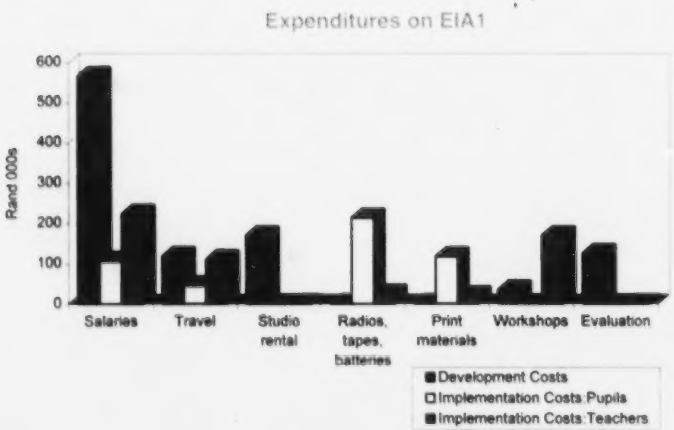
Distribution of Expenditures on EIA1



This produces a unit cost for development of R8,775 a lesson. This includes all radio production costs (studio and talent fees, tapes etc.), the development cost of the print materials (pupil books, teacher manual, posters, charts etc.) accompanying these lessons, but not the cost of regional coordinators' salaries. How can we use this number? If we divide it by the number of users, we get an *indicated unit cost* (i.e. the total cost of producing one book or program that is actually used by a student). In this case, pupil books would cost R4.88, but this is very much higher than the actual printing cost per unit, which is only R1.61. The indicated unit cost of R4.88 reflects all of the books which were printed but not yet used, plus the relatively high fixed development costs of artwork spread over a relatively small print run. So unit costs only take us part of the way in an economic analysis.

Costs of Pupil Instruction Versus Teacher Development

One might assume that most costs relate to producing materials for students. Teacher training costs are often underestimated. In fact, setting development costs aside, OLSET spent as much on teacher training as it did on students for EIA1. The table below separates development and implementation costs for EIA1, with the latter split into pupil and teacher expenditures.



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Present Spending Priorities

How much is "expensive" in South Africa? What is South Africa presently spending on primary education? Before looking at the cost of implementing interactive instruction in the classroom, we have tried to establish a context based on the pattern of expenditures on other systems. How much importance does the system place on instruction, as opposed to expenditures that simply maintain the infrastructure of education? How much is now being spent on instructional materials as opposed to salaries? On what kind of materials? For whom?

It is difficult to find meaningful estimates of unit costs by grade in primary schools. Considerable anecdotal information suggests that unit costs increase in higher grades-- class sizes are larger in the lower grades, teachers are less qualified, less experienced and lower paid, and there are fewer books and other resources in the lower grades. However, no school-based cost studies have been performed in South Africa that could be used to produce reliable estimates. The World Bank/Development Bank of South Africa

Schools spent very little money on teaching materials.

indicates that personnel costs accounted for over 90% of total primary school expenditures in 1991/92. For South Africa as a whole, this averaged R86.10 per primary pupil per year, ranging

from R324.85 in white primary schools to R52.39 per primary pupil per year for all former African authorities. But there was regional variation, too. Bophuthatswana spent R99.88 per pupil, nearly R14 more than the all-South Africa average, but KwaZulu spent less than one third of that average.

Non-personnel expenditures cover more than instructional materials, and they are not separated from other items (textbook purchases are not distinguished from stationery purchases for the administration, for example). However, some fragmentary information does exist. Rob Feldman of Edusource reports that in 1991/92 the DET spent R7.90 per primary pupil on textbooks, and the Transkei spent R13.80 per primary pupil. However, the unreliability of the data is indicated by the fact that KwaZulu is reported as having spent only R0.04 per primary pupil on texts, which is not plausible. In 1991 rands, the average price of a textbook purchased by DET over the period 1987 to 1991 appears to have been R8, implying that DET has been buying a little less than one book per primary pupil per year. Data are missing for many departments, but Feldman's best guess is that on average primary texts cost R7 each, and the African departments have been buying one book per pupil per year.

But the inescapable conclusion is that African primary schools spent very little on textbooks. In the African departments' primary schools in 1991/92, only about 15% of the non-salary expenditure was spent on textbooks. Furthermore, in the years up to 1991/92 non-personnel expenditures per pupil had been falling in real terms across the board, and this trend has probably been continuing.

Costing the System

More than one route to expansion was possible. OLSET had choices in delivery systems and levels of support for teachers, for example, and had to cope with several variables, such as rural and urban differences. We discuss each of the major variables below. Outside of South Africa, other local variables may intervene, and other choices and constraints would present themselves if the audience or the program purpose were to change. So these issues are intended to be informative but illustrative only.

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Radio Broadcasts or Audiocassettes?

OLSET produces master tapes of the programs which are then dubbed onto audiocassettes, labeled and packaged by a commercial firm. This system freed the school from a strict broadcast timetable, and allowed the teacher to listen to the tape before using it with the class, to use each tape more than once and to stop and restart the tape during the lesson. We compared the following packages:

#1 One radio-cassette player, one set of lessons on cassette, one set of class posters/charts, per class; plus one pupil-book per pupil;

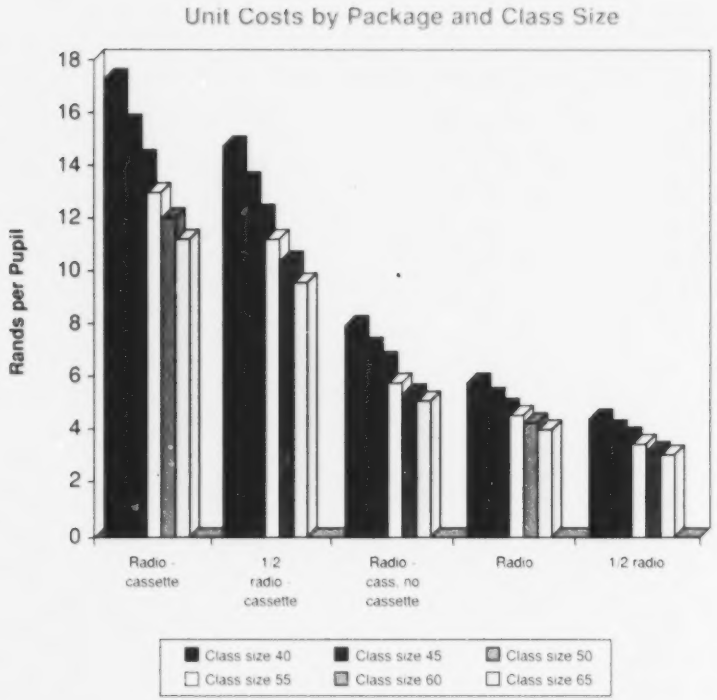
#2 Posters/charts, pupil books, lessons on cassette, but with the radio-cassette player shared between two classes;

#3 Posters/charts, pupil books, but with one radio-cassette per class, no lessons on cassette, allowing the possibility of recording off air, but not supplying blank cassettes;

#4 Posters/charts, pupil books, but with a radio rather than a radio-cassette player;

#5 Posters/charts, pupil books, but with a radio shared between two classes.

The cost differential among the packages is considerable. There are also continuing expenses, such as battery costs. At the 45 pupil class size, this would add R0.59 per as pupil per year for one cassette player per class, R0.29 for a shared cassette player or a radio, and R0.15 for a shared radio. It appears that the recurrent costs of replacing cassettes after the first year (other than normal depreciation) would be in the range of R0.60 per pupil for the average current class size. Radio recurrent costs could be R0.45 or less, depending on participation levels. Because recurrent costs are primarily dependent on print materials, costs will mainly be a function of decisions about print materials (e.g. how many will be used) and the actual cost of printing them.



How Much Support to Teachers?

Teachers presently receive an intensive level of support. The questions facing OLSET are: "How much can users pay for teacher support and development? Would a reduction produce *significant savings?*" The study compares three alternatives.

Optimal. Under the present optimal model, teachers receive, in addition to their manuals, a two-day introductory workshop with print materials, five audio cassettes, participation in four Teacher Support Groups (TSGs) per year, each supported by a regional coordinator, a one-day, mid-year, workshop and a one-day, year-end workshop, and up to six classroom visits by OLSET regional coordinator staff. Parents and principals are encouraged to participate in the TSGs. After the first year of participation, the two-day introductory workshop is replaced with a one-day refresher workshop.

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Intermediate The intermediate model would provide professional support during the year, but would approximately halve the amount, i.e. only two TSGs, three classroom visits, and no year-end workshop. This would permit the ratio of professional support staff to teachers to be halved, but would still require both full-time professional staff devoted to EIA and, at expanded scale, "borrowed" staff for introductory workshops.

Minimal The minimal model consists of the two-day introductory workshop and the five audio cassettes. This model would require professional staff only for the introductory workshops, and therefore would obviously have to rely on borrowed staff who would, themselves, have to be trained.

Unit Costs for Teacher Development and Support Models

These three packages, optimal, intermediate and minimal, are considerably more intensive in the first year and therefore more costly than in subsequent years. Each model is presented with three estimates, based on different costs of travel corresponding to different density of schools and transport costs, described as urban, peri-urban, and rural. The direct costs for the optimal and intermediate models have been raised 10% to cover administrative costs in the field at larger scale, and those for the minimal model have been raised 25% for the same purpose. In these cases, total costs are presented per teacher (and do not vary with class size). To make comparisons simpler, per pupil costs are presented for two class sizes, 40 pupils and 65 pupils. Figures are presented for both the first or introduction year, and for the second and later years. The three packages are as described above.

	Optimal			Intermediate			Minimal		
School type	Cost per teacher	Class of 40	Class of 65	Cost per teacher	Class of 40	Class of 65	Cost per teacher	Class of 40	Class of 65
Yr. 1, rural	640.96	16.02	9.86	389.22	9.73	5.99	156.22	3.91	2.4
Yr. 1, peri-urban	589.6	14.74	9.07	359.87	9	5.54	147.88	3.7	2.28
Yr. 1, urban	538.32	13.46	8.28	330.56	8.26	5.09	139.55	3.49	2.15
Yr. 2, rural	214.5	3.65	3.3	143.08	3.58	2.2	99.91	2.5	1.54
Yr. 2, peri-urban	185.15	4.63	2.85	121.07	3.03	1.86	91.57	2.92	1.41
Yr. 2, urban	155.85	3.9	2.4	99.09	2.48	1.52	83.25	2.08	1.28

Source: author estimates

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The Cost of Program Administration

The cost of program management is real, often overlooked, and usually judged to be too high by people who are not doing it. The type and level of overhead costs are highly dependent on the teacher development and support model used, the way in which expansion actually takes place, and the mix of rural and urban schools. Remote rural schools are much more costly to service and administer. Below we show the cost implications for program administration of the three levels of teacher support described above.

Remote rural schools are much more costly to service and administer.

The "optimal" model. Under an "optimal" model of teacher development and support, full-time implementing staff are needed wherever the program takes place. Experience suggests a reasonable ratio is one implementor to 100 teachers or about 25 schools. As the number of implementors in a given location increases, three consequences follow. First, they need office support (an administrative assistant/scheduler/storekeeper, and a clerk/porter). Second, they need a lead implementor/trainer, and the appointment of such an individual (more qualified and skilled than the other implementors) allows the other implementors to be less qualified and skilled, perhaps reducing salary costs. Third, the presence in the regions of multiple implementors and their lead professional/trainer should greatly reduce the need for, and cost of, travel for professional staff from the center for regional workshops. The overall impact is difficult to estimate, but in the cost projections 10% has been added to the direct costs of teacher development and support to cover this administrative cost.

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The "intermediate" model. The "intermediate" model would also require full-time staff where the program was implemented, but each implementor would be responsible for double the number of schools and teachers (the intensity of INSET during the school year being halved). However, there would likely be a peak-load problem at the beginning of the school year, which would require more input of professional staff from the center and almost certainly the use of some part-time or 'borrowed' professional staff. It seems reasonable that the likely range of administrative overhead for the optimal model above is probably appropriate here too, i.e. the overhead would not amount to more than 10% of the teacher development and support direct costs, and that percentage add-on is built into the cost projections.

The optimal model requires full-time, professional staff.

The "minimal" model. The "minimal" model is very different. No face-to-face INSET is delivered during the year, so there is no need for full-time professional staff in the provinces. Introductory workshops would need to be conducted by head office staff and part-time or borrowed staff. However, there would be a need to ensure battery supply [assuming that schools do not supply their own], radio repair and replacement, and materials delivery, so some administrative staff would be required to ensure this. The administrative cost might be as much as 25% of the very much reduced direct cost of teacher development and support, so this percentage add-on is built in to the cost projections and unit cost estimates for the minimal model.

Class Size

Class sizes vary considerably. For African primary education as a whole, the average pupil/teacher ratio in recent years has been about 44:1, but the ratio for Transkei in 1990, for example, was 58.9:1. There is also wide variation across inspectorate circuits within authorities: in Gazankulu in 1992, the pupil/classroom ratio varied from 56:1 to 81:1 across circuits. Furthermore, pupil/teacher ratios are not necessarily a good guide to actual class-group sizes because teachers do not necessarily work the same hours as pupils in the classroom. Thus there is reason to believe that many Grade One and Grade Two class groups, especially in rural areas, may be considerably larger than the average that OLSET has experienced so far, which is about 45. Accordingly, in the presentation of unit cost data, we show costs per class group of 45, but also show costs per pupil for a range of class sizes from 40 to 65, which should encompass the range likely to be encountered in practice.

Actual Prices and Costs of the Packages

In today's South Africa, the actual cash costs of implementation, compared to similar costs of alternatives and probable budgetary resources, is the major issue facing educators. We have assumed that school supply practices remain essentially unchanged and focus on the acquisition costs in a year that the program is acquired for a school, plus separately the continuing recurrent costs per year in subsequent years. The implicit assumption is that there will be some additional annual cost to replace lost and destroyed materials and repair radios (20% of acquisition cost according to current supply models). Throughout, the development costs of materials (audio lessons, printed materials), which have already been expended, are treated as sunk costs and ignored: the cost estimates are based on the variable or opportunity costs of obtaining the additional copies of the materials.

First, we describe what the materials cost to produce. Prices vary enormously from country to country and readers may wish to compare South African costs with their own. For this study, input prices and costs have been based on either actual recent OLSET bills, or price quotations received from suppliers. It is probable that at greatly enlarged scale some reductions in unit prices could be achieved, but no allowance is made for this in the analysis.

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Printing: 10.1 South African cents per page, including A4 paper, if printed one side only in black and white on white paper; 8.05 cents per page, if printed both sides; printing on colored paper cost a further 4.3 cents per sheet; 11.425 cents per page for printing fullcolor comics (both sides), after fixed costs of approximately R1,071 per page for artwork. Printing on newsprint rather than white paper would reduce costs considerably, but in South Africa it only makes sense on a large scale and was opposed by OLSET staff on grounds of poor durability. In countries where texts are often produced this way, much lower unit costs for print materials would be achieved. In Pakistan, for example, pupil books of 128 pages are printed for about US$0.30 per book.

Posters: R2.36 each after fixed artwork costs of about R4,780 each. A3 blowups of pupil workbook pages (EIA1) R1.20 each; alphabet frieze (EIA1) R1.80 each; color chart (EIA1) R2.20 each; EIA1 'Readiness Kit' R10.78 each (based on current costs but lower-cost packaging than currently used, estimated at R1 a unit).

Cassettes: R5.68 per dubbed, packaged, and labeled audio cassette carrying two lessons. Actual cost for the dubbed cassette is invoiced at only R2.73; packaging adds R2.23 and labeling the further R0.72 [all prices inclusive of VAT].

Radio-cassette players: R169.86 each, OLSET's current price.

Radios: R100 each.

Batteries: R13.26 for a set of six D cell batteries, assumed required 2 sets per year for radio-cassette players, only one set per year for radios.

Distribution: Actual OLSET expenditures to date appear to have averaged about R73.09 per class participating in EIA. A range from R50 to R150 per class, depending on location, seems reasonable.

Personnel, travel, and accommodation: OLSET's average employment cost per regional coordinator is R229.29 per working day, and this is used for professionals in teacher development. The employment cost of OLSET regional coordinators appears to be slightly higher than the grading of the staff government would use. OLSET's current regional coordinators average about 150kilometers per day reimbursed at 0.75 cents per km. Travel costs for regional coordinators for TSGs and class visits are varied according to the

nature of the area (density of schools). For travel by professional staff to workshops in centers other than their duty station, an average airfare of R700 has been assumed. For accommodation and meals for professional staff at workshops etc., the OLSET maximum per diem reimbursement of R235 per day is used.

Air-time costs. For broadcast options, costs would normally be expected to differ depending on coverage area. SABC quoted air-time costs for one hour broadcasts (EIA1 and 2, 30 minutes each) on 150 school days a year at R900 per hour less a discount producing a net cost of approximately R600 per hour for nationwide coverage on Radio 2000, a widely heard FM station. This would correspond to R39,000 per year for EIA1; annual per pupil airtime costs obviously depend on participation levels. At current EIA1 enrollment levels, the cost would be R2.57 per pupil per year. Total Grade One enrollment in 1993 in African schools was 1,338,000 pupils; if 10% of that number were participating in EIA1, the annual per pupil cost would be R0.29.

What a Difference an Option Makes...

With so many alternatives discussed in the original study, we have selected materials packages #2 and #5, i.e. shared players/radios, and a class size of 45, to demonstrate the most likely options. We show the range of costs per class and per pupil for both the first year and recurrent annual expenditure, based on alternative teacher development and support packages and a range of travel and distribution costs from high to low. The highest cost alternatives are the current teacher development package in remote, rural areas, the lowest the minimal package in urban areas. The recurrent estimates include the 20% of materials cost depreciation allowance, and all estimates include airtime costs on the assumption of 10% participation nation-wide. The ranges are presented below.

The Highs and Lows: Combined Unit Costs for Various EIA1 Packages per Class of 45 and per Pupil, in Rand

Package	Yr. 1, per class of 45	Yr. 1, per pupil (class of 45)	Recurrent, per class of 45	Recurrent, per pupil (class of 45)
Optimal teacher support, rural areas, using cassettes	1,390.36	30.9	367.26	8.16
Minimal teacher support, urban areas, using cassettes	788.95	17.53	216.39	4.81
Optimal teacher support, rural areas, using radio	992.56	22.06	271.85	6.04
Minimal teacher support, urban areas, using radio	391.15	8.69	140.63	3.13

Source: author estimates

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Although the range of possible unit costs may seem very large, this reflects the considerable differences in the alternative teacher development packages, and the very real cost differences (because of distribution and travel costs) in rural and remote as opposed to densely-settled and large urban areas. To offer such a wide range of estimates may seem inconclusive; however, it is also a reflection of reality and the range of alternatives under consideration.

Ways to Reduce Unit Costs

All the above unit cost estimates and cost projections have been made at the prices OLSET currently faces, and on the teacher development and support models OLSET considers appropriate. But these assumptions may not apply when the methodology is taken to scale. At very large scale, both print costs and cassette costs should be reducible by changes in technology and purchasing methods. If the program becomes a public sector initiative, VAT is no longer a net cost. Accordingly, it is reasonable to suppose that materials costs could be reduced by 25%. Secondly, even on the minimal teacher development and support model, there is a continuing one day refresher workshop for all teachers. This may well not be essential; teachers could probably use the program satisfactorily with only their initial two day workshop their first year, and then no further development or support specific to the program except that inherent in use of the materials themselves. However, because of teacher turnover, pregnancy leave, etc., each year one would expect some teachers in schools already using the program to be new to it -- a reasonable estimate might be 10% -- and they would need the introductory workshop even though the school was already using the program.

These assumptions imply that using the radio shared between two classes, and an airtime cost based on 100% coverage, the first-year acquisition costs per pupil in a class of 45 could be reduced to R6.92 for EIA1 and R9.22 for EIA2, ignoring distribution costs but costing teachers' introductory workshops on the basis of rural teachers' travel costs. The effect on recurrent costs is even more striking, since so much of the recurrent cost is the continuing teacher development and support that is now omitted, except for initial training for new teachers because of teacher turnover. At EIA1 level, recurrent costs per pupil in a class of 45 would be R1.21 annually; at EIA2, R1.68 annually. Both these recurrent cost estimates are less than the 20% allowance for replacement applied to an average conventional textbook price [20% for replacement and

repair on materials cost is included in the EIA recurrent estimate]. A further marginal reduction could be made if radios were shared between three classes rather than two, but that may not be wholly practical.

What Does All This Mean?

First, the intensity of teacher development and support makes a very large difference to the cost of implementing EIA. Using cassette delivery, the optimal model of teacher development and support raises first year costs almost 50% compared to the minimal model. With radio, the effect is even stronger: the optimal teacher development and support is estimated as 89% more expensive in the first year than the minimal model. Given the overall cost of the EIA program, this obviously raises questions about the feasibility of including intensive teacher development and support specifically linked to EIA.

The intensity of teacher development makes a very large difference to the cost of implementing EIA .

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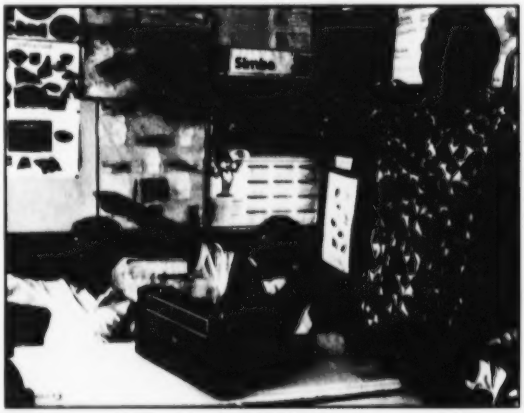
Second, it is clear that EIA is not extraordinarily cheap in the first year, even if delivered by broadcast radio. At the low end, the per pupil *first year cost* (which includes teacher training) is comparable to the unit cost of textbooks purchased for primary school pupils (in 1994 Rand, that probably averages about R9.33). The *recurrent cost* is less than the cost of one text a year, even at the most intense teacher development and support model, and at the low end is only about 40% of the cost of a textbook. However, if we abandon much of the continuing teacher development and support, and assume some cost savings on materials from going to scale, the recurrent cost even of EIA2 can be reduced to *well below the cost of a textbook.* Thus the affordability of EIA depends crucially on policy decisions with respect to expenditure on non-teacher inputs to the lowest grades of primary schooling, and policy decisions on teacher support and development. In the past, spending on instructional materials at Grade One and Grade Two has been absolutely minimal, as mentioned above. Conventional wisdom would suggest that it should be increased drastically and quickly, in order to improve performance in those grades in the most cost-effective way. If this occurs, then EIA would clearly be affordable.

Comparisons with Competing Programs

There is no comparable audio-based ESL program for lower primary schools in South Africa. However, there are a number of other English programs, some commercial programs available from publishing houses, others produced and distributed by NGOs. For purposes of comparison, the per pupil costs of the materials for some of these alternative programs are compared below with those for the materials only of EIA.

EIA by radio is cheaper than text based alternatives.



Approximate estimates of per pupil costs, by class size ranging from 40 to 75, were obtained from information provided by the distributors of the programs. The four programs on which information is provided are as follows:

MAPEP. This program is distributed by MacMillan Boleswa. At each of the grades from Grade One to Three, there is a pupil book which costs R8.95, and a class kit [including a teacher's manual] which costs R109. The series continues through higher primary, with higher costs in the higher grades.

Molteno Bridge to English and *Bridge Plus One.* Molteno is an NGO. The Molteno program is designed for Grade Two, after pupils have completed the Molteno program Breakthrough to Literacy (in the vernacular) in Grade One. Molteno reports that in some private schools, *Breakthrough* is completed in pre-primary, and *Bridge* done in Grade One, but this is unlikely to be feasible in ordinary African primary schools, so *Bridge* is shown as a Grade Two program. Molteno packages include teacher's manuals, pupil books, wall charts, games, and other class items. Molteno will only supply to teachers who have been trained in the use of their materials, but no information on training costs is available.

New Day by Day. This series is distributed by Maskew Miller Longman. It includes pupil books (at Grade Three, both a reader and a language book), teachers' guides, wall charts, flash cards, and a cassette at each level.

Starting English. This program, devised by the NGO ELMAP and obtainable either from them or from Heinemann Centaur, is considerably different from the others. It is a kit based on a particular approach to language teaching, and does not include individual pupil materials. The kit includes manuals, story posters, rhyme and song charts, and the like, and costs R150 for a kit intended for a class of 40. The kit is intended for Grade One, and the entries in the table are calculated on the basis that if there are more than 40 pupils in the class, two kits are needed. ELMAP engages in extensive training of teachers to use its methods, but no information is available on their training costs.

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There is a very real problem of how to present per pupil costs of these programs and of EIA, in a way that permits meaningful comparison. First, as already noted, there is no good basis for estimating the expected life of the radios or the cassettes in the environment of rural South African primary schools, and the experience of OLSET over the past 18 months is not necessarily a good guide. Secondly, regardless of the actual expected life of materials, the administrative practice in South Africa with respect to the supply of instructional materials has been rigid and mechanical. In principle, departments have supplied schools with materials such as textbooks on a cycle which permits resupply with new materials at most once every five years. Between full replenishments at these five year intervals, the principle is that 20% resupply is permitted to cover depreciation (loss, destruction, wear and tear) of materials. It is unclear how enrollment growth between resupply is handled, but suggestions are that the 20% depreciation allowance is supposed to cover this.

Given the current purpose, it seems appropriate to report the acquisition costs of each program in the year it is first purchased. If past policy is continued, in years after the first, 20% of this cost would be incurred to cover depreciation/losses etc. The only exception to this is EIA, where there is a recurrent cost in the form of batteries [given that the expected life of the radios is greater than five years under normal conditions, it is assumed that the 20% depreciation will cover repair costs for radios]. At current best estimates, the cost of batteries for a radio is R13.26 per class per year, or R0.33 per pupil for a class size of 40. The table reports acquisition costs only, and distribution costs are omitted. The EIA package listed is #5, with shared radio.

Per Pupil Costs of Lower Primary English Programs.
Materials only in 1994 Rands

Class size	40	45	50	55	60	65	70	75
Grade One:								
MAPEP	11.68	11.39	11.13	10.93	10.77	10.63	10.51	10.4
New Day by Day	9.23	8.91	8.64	8.43	8.25	8.1	7.97	7.86
Starting English	3.75	6.67	6	5.45	5	4.62	4.29	4
EIA1 Radio	4.52	4.19	3.93	3.72	3.55	3.4	3.27	3.16
Grade Two:								
MAPEP	11.68	11.39	11.13	10.93	10.77	10.63	10.51	10.4
Molteno Bridge	11.41	11.08	10.81	10.59	10.41	10.26	10.13	10.01
New Day by Day	10.23	9.91	9.64	9.43	9.25	9.1	8.97	8.86
EIA2 Radio	7.55	7.25	7	6.81	6.64	6.5	6.38	6.28

Source: Distributors for basic information, author calculations

The table shows that if we consider materials acquisition costs only, ignoring teacher development and support (which is fair, because that is what is done for all the programs), EIA1 by radio is cheaper than the text based programs at all class sizes, and is similar in cost to *Starting English*. This would remain broadly true if a reasonable addition was made for per pupil airtime costs, e.g. on the basis of 10% participation (airtime costs are then about R0.29 per pupil).

EIA2 by radio is cheaper than the alternatives at all class sizes, and this would again remain true with a reasonable addition for airtime costs (R0.45 per pupil at 10% participation). If EIA were taken to the Grade Three level, where the alternative programs become more expensive, and its costs were held to the EIA2 level, it would be cheaper than most of the alternatives, even by cassette.

Benefits and Cost Savings

How does one factor in the known effectiveness of the interactive instructional system? The schools using EIA1 programs showed learning gains 20 points higher than for conventional schools. Doesn't this have some economic value?

This issue is particularly important in South Africa. One of the most striking features of African education in South Africa is the very high level of internal inefficiency, as measured by pupil repetition rates and exit rates. Although the data are not wholly reliable, and are subject to some dispute, the rates as reported are very high.

Repetition and Exit Rates, 1991

Grade	Repetition Rate, Rural Africans, %	Dropout Rate, All Africans, %
Grade 1	16.63	15.99
Grade 2	14.87	4.88
Grade 3	15.37	4.49
Grade 4	12.3	3.91
Grade 5	15.45	6.11
Grade 6	11.83	5.14

Sources: Repetition rate from EDUSOURCE DATA NEWS, June 1994, p 11,
exit rate is RIEP's "Outflow", Education and Manpower Development 1991, table 8

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One way to summarize the internal efficiency of an education system is to calculate the implied number of years of schooling that are provided for each entrant into a given grade, on the assumption that the repetition and drop out rates remain constant and are the same for repeaters as for first timers. This is done by tracing a hypothetical cohort through the system, keeping track of all repeaters, and then summing the pupil-years of schooling delivered in, say, Grade One through Grade Three to the cohort, and dividing it by the total number of members of the cohort who eventually reach Grade Four. Performing this calculation for the transition rates in the table above implies that for each pupil reaching Grade Three, 4.24 pupil-years of education have been delivered, rather than the 3 years that would be the case if there was no repetition or drop out. This reflects a highly inefficient system: basically, it implies that enrollment in Grade One through Grade Three is over 40% higher than the number entering Grade Four would require in the absence of repetition and dropout. Rather obviously, any innovation that reduces repetition or dropping out will improve the efficiency of the system by this measure, and is therefore valuable.

Initial Evaluation Results of EIA and Implications for Internal Efficiency

The initial evaluation results of EIA1 indicate that the pupils in EIA1 achieved measurably higher English language gains, in the order of a 20-point difference over a complete year, than pupils in the control schools. Second, a number of teachers reported that attendance of pupils was better, and dropout (exit) lower. So, improving achievement should lead to reduced repetition, because in South Africa even in lower primary repetition decisions are largely examination-driven.

So EIA may improve attendance, and reduce repetition and dropout. If so, it will be valuable. Because we do not know by how much repetition and dropout would be reduced, we cannot be precise about this value. It is also true that the value may not manifest itself in cost savings, because reducing dropout implies that pupils will stay in school longer and continue to require educational resources to be devoted to them. However, given the objective of government to have all children complete ten years of schooling, reduced drop out is a benefit.

One fairly simple way to indicate the order of magnitude of the potential benefits of reduced repetition and exit is to calculate the implied pupil-years per Grade Four entrant from the reduced rates, and then compare that to the pupil-years implied by the original rates. The reduction can then be expressed as a fraction and multiplied by the per pupil cost of primary schooling. By appeal to the notion of the resources required to get a pupil into Grade Four, this then gives an indication — it should be emphasized, no more than an indication — of the per pupil value of an innovation that would reduce repetition and dropout rates by that amount.

The following table summarizes the results of such calculations. The first column lists different levels of reduction in repetition and dropout. The second column then shows the calculated impact on the number of pupil years of education delivered per Grade Four entrant. The third column shows this as a percentage reduction from the actual 1991 base. The remaining four columns put a monetary value on reducing repetition and dropout using 1991 per-pupil expenditure levels in primary schools 1) for all African pupils, 2) students in DET schools, 3) the highest spending bantustan authority (QwaQwa) and 4) the lowest (Transkei) spending bantustan authority.

The Per Pupil Annual Value of Reducing Repetition and Dropout Rates, African Lower Primary Schools

Repetition and Dropout Rates	Pupil-years to reach Grade 4	% Savings	Cost per pupil/year, based on 1991/92 mean	DET cost per pupil/year	QwaQwa cost per pupil/year	Transkei cost per pupil/year
1991	4.243	N/A.(0)	R789	R980	R1281	R486
Down 5%	4.153	2.13%	R772	R959	R1253	R476
Down 10%	4.067	4.15%	R756	R939	R1228	R466
Down 15%	3.985	6.08%	R741	R920	R1203	R456
Down 20%	3.907	7.92%	R727	R902	R1126	R447
Down 25%	3.832	9.50%	R714	R887	R1159	R440

Entries in the first row are the actual per pupil primary school expenditures in 1991/92. Source of per pupil expenditure estimates: Fielden and Buckland, Public Expenditure on Education in South Africa [Draft, January 1994; Urban Foundation Edupo], Appendix 4.

It is clear from this table that even a 5% reduction in repetition and exit rates from the lower standards of African primary schools has a potential value of the order of R10 per pupil per year even in the

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lowest resourced schools. Larger reductions, and higher levels of per pupil expenditure in primary schools, increase the value of the savings. However, it is clear that if EIA can reduce repetition and exit rates in African lower primary schools by as little as 5%, it *can plausibly be expected, on average, to generate benefits greater than its costs.*

The South African experience differs from other countries in its unusually intensive teacher support. Typically, teacher training for interactive instruction in other countries has provided initial orientation in the use of the materials and the interactive instruction system in the classroom, and further contact with teachers has been minimal. This case study shows for the first time the cost of adding more systematic teacher support in the context of a broader instructional package. In South Africa, the designers felt that regular teacher support made a significant difference to the implementation of interactive instruction, both during the radio lesson and to the active learning strategies adopted by teachers in their regular teaching. But it added significantly to the cost.

EIA 1 students have better English language skills, better attendance and lower drop out rates.

The piece of string can vary greatly in its length. The case of South Africa is not so different from most other countries. The cost elements described here apply in most countries, although the costs themselves will vary. Most important, the value that interactive instruction adds to learning in the classroom has shown itself to be a worthwhile investment in most countries.